



US009069362B2

(12) **United States Patent**
Weeden

(10) **Patent No.:** **US 9,069,362 B2**
(45) **Date of Patent:** **Jun. 30, 2015**

(54) **SYSTEM AND METHOD FOR COOLING AND PROMOTING PHYSICAL ACTIVITY OF POULTRY**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 665 days.

(21) Appl. No.: **12/704,885**

(22) Filed: **Feb. 12, 2010**

(65) **Prior Publication Data**

US 2011/0202186 A1 Aug. 18, 2011

(51) **Int. Cl.**

A01K 31/00 (2006.01)

G05D 23/19 (2006.01)

G05D 7/06 (2006.01)

(52) **U.S. Cl.**

CPC **G05D 23/1931** (2013.01); **G05D 7/0635** (2013.01)

(58) **Field of Classification Search**

CPC **A01K 31/00**

USPC 119/416, 420, 421, 436, 437

See application file for complete search history.

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Primary Examiner — Kristen C Hayes

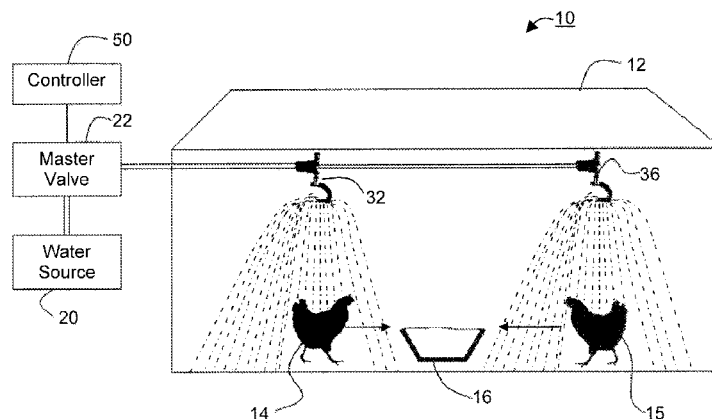
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(57)

ABSTRACT

A sprinkler controller in a poultry house having a processor, a data storage device operatively connected to the processor, the data storage device having instructions for programming the processor, and an input/output module operatively connected to the processor. The input/output module is configured to communicate with at least one valve for controlling a flow of fluid between a fluid source and at least one sprinkler nozzle. The at least one valve has an open position permitting the flow of fluid, and a closed position inhibiting the flow of fluid, and the position of the valve being determined by the processor. The processor is programmed to set the valve in the open position at a start of an activity promotion interval, and to set the valve in the closed position at the end of the activity promotion interval. The duration of the activity promotion interval is selected such that a sufficient amount of fluid is dispersed through the sprinkler nozzle to promote physical activity in the poultry. The start of the activity promotion interval is predetermined based on a frequency of operation parameter indicative of a number of activity promotion intervals in a time period, and a value for the frequency of operation parameter being selected to promote growth of the poultry.

28 Claims, 7 Drawing Sheets



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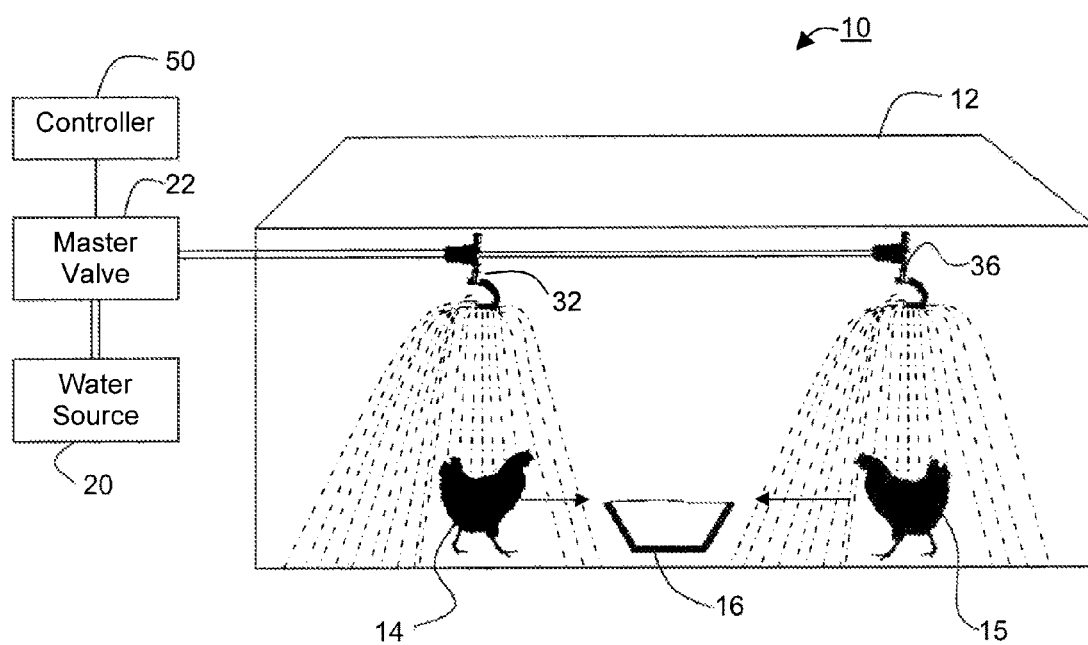


FIGURE 1

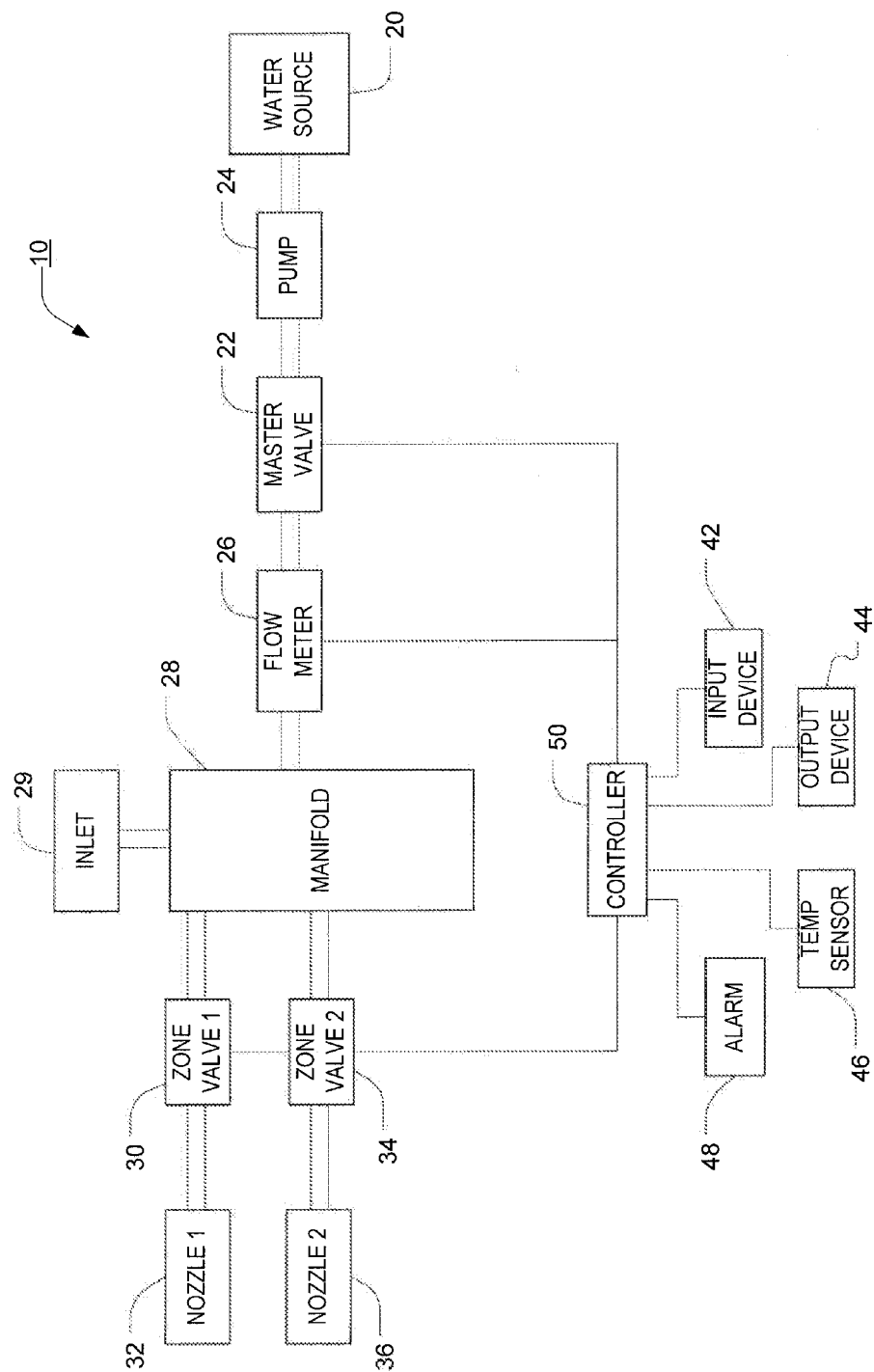


FIGURE 2

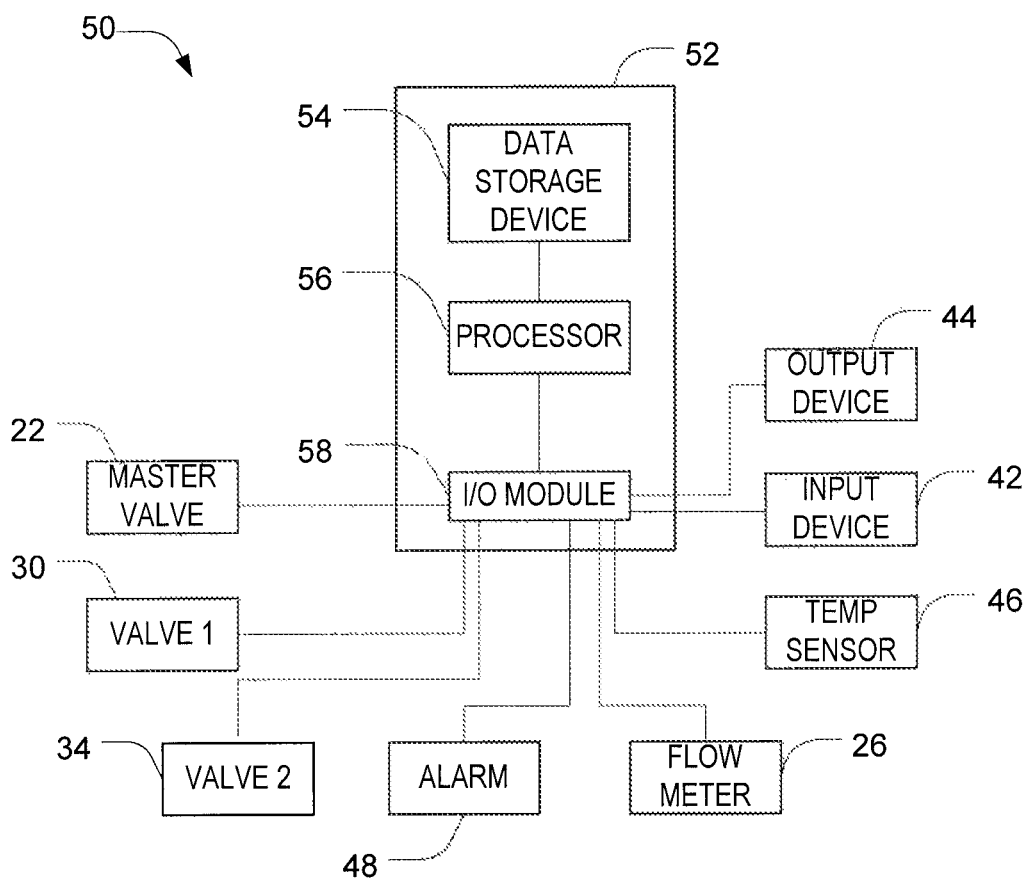


FIGURE 3

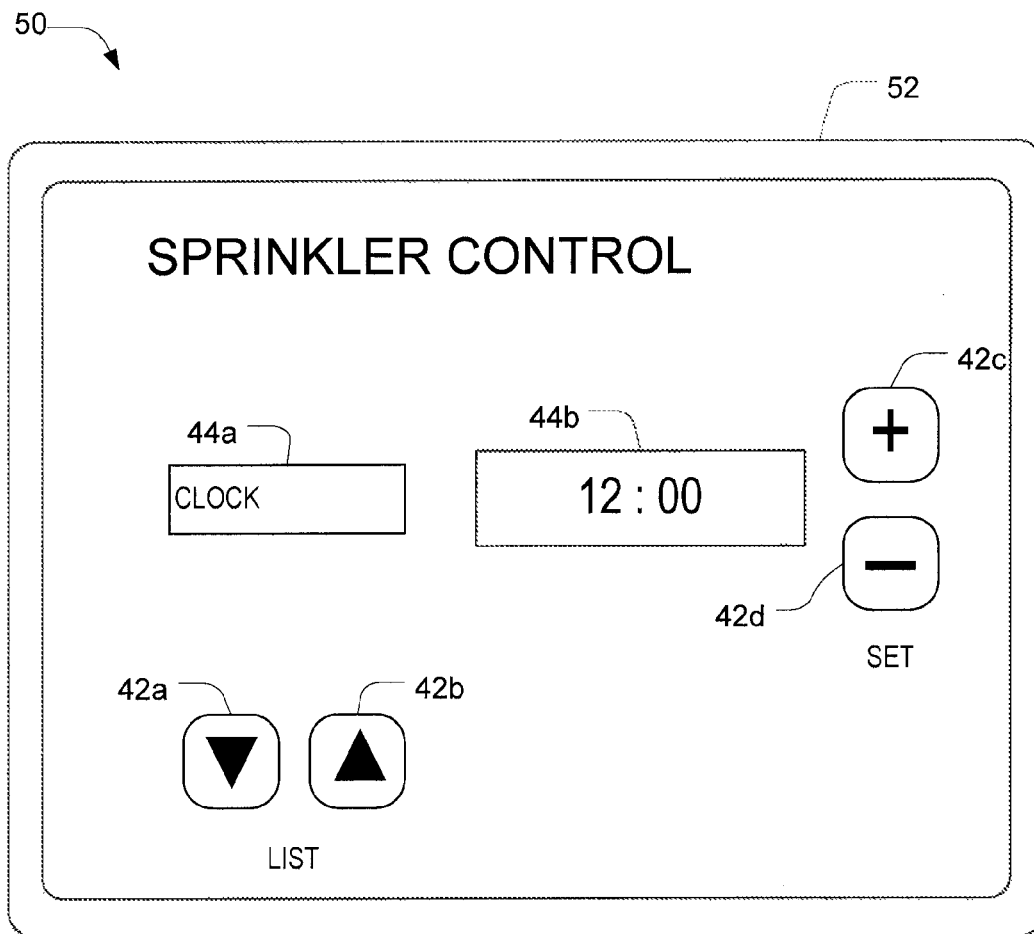



FIGURE 4

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**FACTORS AFFECTING FREQUENCY AND/OR DURATION OF ACTIVITY
PROMOTION INTERVALS**

AMOUNT OF WATER DISPENSED IN A TIME PERIOD
AGE OF THE POULTRY
TYPE OF POULTRY BEING HOUSED
TIME OF DAY
PURPOSE OF THE POULTRY
DESIRED WEIGHT OF THE POULTRY
SEX OF THE POULTRY

FIGURE 5

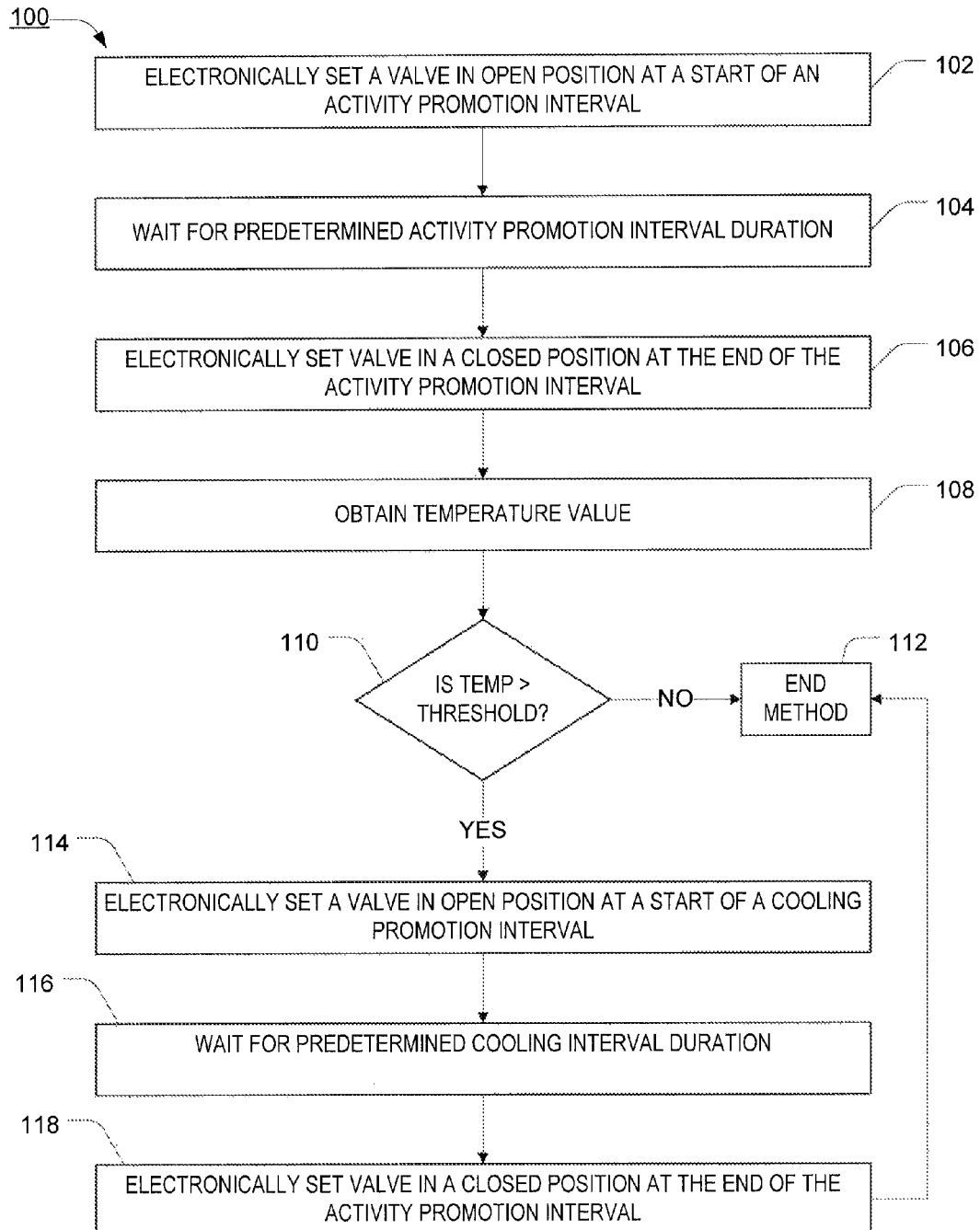


FIGURE 6

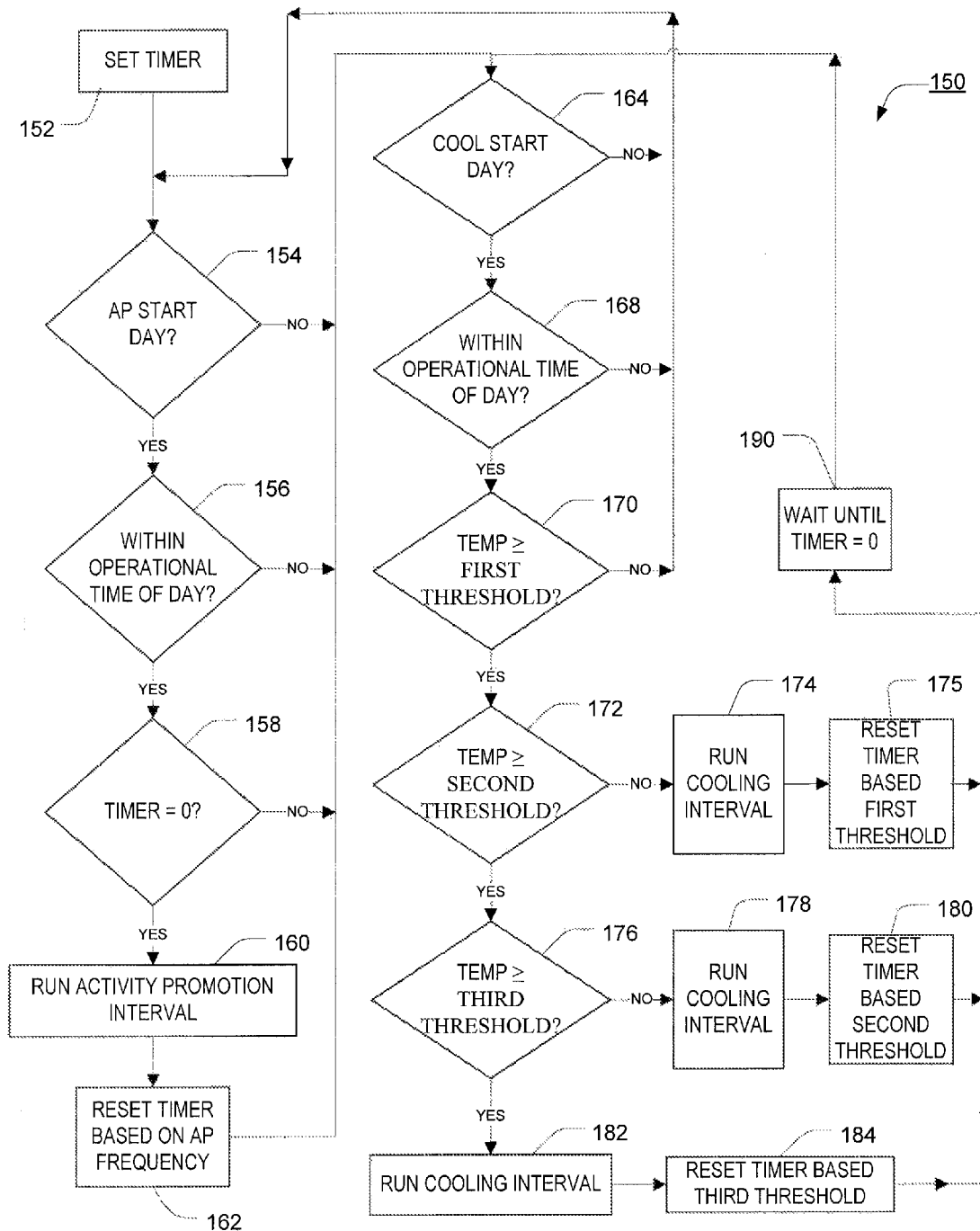


FIGURE 7

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SYSTEM AND METHOD FOR COOLING AND PROMOTING PHYSICAL ACTIVITY OF POULTRY

FIELD

The invention relates to sprinkler systems, and in particular, to methods and systems for controlling sprinkler systems in poultry houses.

INTRODUCTION

Poultry such as chickens, turkeys, ducks, and geese are a popular food resource. Majority of poultry are raised using various farming techniques, which include free-range as well as intensive farming. A poultry house provides shelter to the poultry during the growth cycle of the poultry. The growth cycle of poultry may differ based on the species of the poultry being farmed. For example, the growth cycle of broiler chicken typically ranges from one-day-old chicks at growth day one to maturity in about six weeks when they are harvested.

Poultry raised in poultry houses lead a generally sedentary lifestyle being in a seated position throughout most of the day. This sedentary lifestyle involves very little physical activity and may not be desirable for growth and/or health reasons.

A controlled amount of physical activity at certain stages in the growth cycle is desirable because the physical activity is conducive to the growth of the poultry. On the other hand, an excessive amount of physical activity is undesirable because it may inhibit growth.

Temperature control in a poultry house is also necessary to prevent mortality of the poultry from excessive ambient temperature. It is desirable to maintain the ambient temperature in the poultry house below a specific threshold.

Accordingly, there is a need for systems and methods for controlling sprinklers in poultry houses, which addresses at least some of the above concerns.

SUMMARY

According to one embodiment of the invention, there is provided a sprinkler controller in a poultry house comprising a processor, a data storage device operatively connected to the processor, the data storage device having instructions for programming the processor, and an input/output module operatively connected to the processor.

The input/output module is configured to communicate with at least one valve for controlling a flow of fluid between a fluid source and at least one sprinkler nozzle. The at least one valve has an open position permitting the flow of fluid, and a closed position inhibiting the flow of fluid, the position of the valve being determined by the processor.

The processor is programmed to set the valve in the open position at a start of an activity promotion interval, and to set the valve in the closed position at the end of the activity promotion interval, a duration of the activity promotion interval being selected such that a sufficient amount of fluid is dispersed through the sprinkler nozzle to promote physical activity in the poultry, the start of the activity promotion interval being predetermined based on a frequency of operation parameter indicative of a number of activity promotion intervals in a time period, and a value for the frequency of operation parameter being selected to promote growth of the poultry.

According to another embodiment of the invention, there is provided a method for promoting activity in poultry in a

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poultry house. The method comprises electronically setting a valve in an open position to permit fluid to flow through the valve at a start of an activity promotion interval. The valve controls a flow of fluid between a fluid source and at least one sprinkler nozzle directed at the poultry. The method also comprises waiting for a predetermined duration of the activity interval. The duration is selected such that a sufficient amount of fluid is dispersed through the sprinkler nozzle at the poultry to promote physical activity in the poultry without over soaking the poultry house. The method also comprises electronically setting the valve to a closed position to inhibit fluid from flow through the valve at the end of the activity promotion interval to prevent an excessive amount of fluid from being dispersed into the poultry house. The start of the activity promotion interval is predetermined based on a frequency of operation parameter indicative of a number of activity promotion intervals in a time period. The value for the frequency of operation parameter is selected to promote growth of the poultry.

According to another embodiment of the invention, there is provided a sprinkler system for a poultry house having at least one sprinkler nozzle directed at the poultry, a fluid source connected to the at least one sprinkler nozzle, at least one electronically controlled valve connected to the fluid source and the sprinkler nozzle for controlling the flow of fluid. The at least one valve has an open position permitting the flow of fluid, and a closed position inhibiting the flow of fluid. The sprinkler system also includes a controller comprising a processor and a data storage device operatively connected to the processor. The data storage device has instructions to program the processor. The sprinkler system also includes an input/output module operatively connected to the processor. The input/output module is configured to communicate with the at least one valve to set the position of the valve.

The processor in the controller is programmed to set the valve in the open position at a start of an activity promotion interval, and to set the valve in the closed position at the end of the activity promotion interval. The duration of the activity promotion interval being is such that a sufficient amount of fluid is dispersed through the sprinkler nozzle to promote physical activity in the poultry. The start of the activity promotion interval is predetermined based on a frequency of operation parameter indicative of a number of activity promotion intervals in a time period. A value for the frequency of operation parameter is selected to promote growth of the poultry.

According to another embodiment of the invention, there is provided a non-transitory physical computer-readable storage medium upon which a plurality of instructions are stored, the instructions for performing operations comprising electronically setting a valve in an open position to permit fluid to flow through the valve at a start of an activity promotion interval. The valve controlling a flow of fluid between a fluid source and at least one sprinkler nozzle directed at the poultry. The operations also include waiting for a predetermined duration of the activity interval, the duration being selected such that a sufficient amount of fluid is dispersed through the sprinkler nozzle at the poultry to promote physical activity in the poultry without over soaking the poultry house. The operations also include electronically setting the valve to a closed position to inhibit fluid from flow through the valve at the end of the activity promotion interval to prevent an excessive amount of fluid from being dispersed into the poultry house. The start of the activity promotion interval is predetermined based on a frequency of operation parameter indicative of a number of activity promotion intervals in a time

period. The value for the frequency of operation parameter being selected to promote growth of the poultry.

DRAWINGS

For a better understanding of the embodiments described herein and to show more clearly how they may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings which show at least one exemplary embodiment, and in which:

FIG. 1 is a schematic diagram illustrating some components of a system for promoting activity in poultry according to one embodiment;

FIG. 2 is a block diagram of the system for promoting activity in poultry shown in FIG. 1;

FIG. 3 is a block diagram of the controller shown in FIG. 1;

FIG. 4 is a top view of a front of the controller shown in FIG. 1;

FIG. 5 is a table illustrating the factors that may affect frequency and/or duration of activity promotion interval performed by the controller shown in FIG. 1.

FIG. 6 is a block diagram illustrating the steps of a method for promoting activity in poultry according to another embodiment.

FIG. 7 is a block diagram illustrating the steps of a method for promoting activity in poultry according to another embodiment.

DESCRIPTION OF VARIOUS EMBODIMENTS

It will be appreciated that numerous specific details are set forth in order to provide a thorough understanding of the exemplary embodiments described herein. However, it will be understood by those of ordinary skill in the art that the embodiments described herein may be practiced without these specific details. In other instances, well-known methods, procedures and components have not been described in detail so as not to obscure the embodiments described herein. Furthermore, this description is not to be considered as limiting the scope of the embodiments described herein in any way, but rather as merely describing the implementation of the various embodiments described herein.

The embodiments of the systems and methods described herein may be implemented in hardware or software, or a combination of both. However, preferably, these embodiments are implemented in computer programs executing on programmable computers each comprising at least one processor, a data storage system (including volatile and non-volatile memory and/or other storage elements), at least one input device, and at least one output device. For example and without limitation, the programmable computers may be a programmable electronic controller, mainframe computer, server, personal computer, laptop, personal data assistant, or cellular telephone. Program code is applied to input data to perform the functions described herein and generate output information. The output information is applied to one or more output devices, in known fashion.

Each program may be implemented in a high level procedural or object oriented programming and/or scripting language to communicate with a computer system. However, the programs can be implemented in assembly or machine language, if desired. In any case, the language may be a compiled or interpreted language. Each such computer program is preferably stored on a storage media or a device (e.g. read only memory (ROM) or magnetic diskette) readable by a general or special purpose programmable computer, for configuring and operating the computer when the storage media or device

is read by the computer to perform the procedures described herein. The inventive system may also be considered to be implemented as a computer-readable storage medium, configured with a computer program, where the storage medium so configured causes a computer to operate in a specific and predefined manner to perform the functions described herein.

Referring to FIG. 1, illustrated therein are some components of a system **10** for promoting activity in poultry according to one embodiment of the invention, shown installed in an exemplary poultry house **12**. The poultry house **12** is shown housing two chickens **14** and **15**, each representative of a multiplicity of chickens. The poultry house **12** is intended for illustrative purposes only. In commercial embodiments, the poultry house **12** may be of other shapes and sizes as known to one skilled in the art, providing shelter to thousands of birds. The commercial poultry houses may also feature artificial lighting conditions to stimulate growth. The poultry houses may also have water delivery system for providing drinking water. In the current embodiment, the poultry house **12** has a water trough **16** as shown. The floor of a poultry house may be covered in litter such as wood shavings, straw or rice hulls.

The poultry house **12** has installed two sprinkler nozzles **32** and **36** directed at the chickens **14** and **15** respectively. While the nozzles **32** and **36** are illustrated to be located at the ceiling of the poultry house **12**, they may be placed elsewhere as long as the output from the nozzles are directed at the poultry. The head of the nozzles are configured to produce micro droplets of water such that a desired amount of water may be sprayed into the barn over a time period. This prevents over soaking the poultry as well as the floor of the barn, which may be covered in litter. As shown in FIG. 1, the sprinkler nozzles **32** and **36**, when activated, spray a fine mist of water at the chickens **14** and **15**. The chickens **14** and **15** react to the spray of water by standing up from the resting position and moving. The chickens **14** and **15** may be prompted to move towards the water trough **16** to have a drink of water from the water trough as indicated.

Referring to FIG. 2, illustrated therein is a block diagram showing various components of the system **10**. The system **10** comprises a water source **20**, connected to a master valve **22**, a pump **24**, a flow meter **26**, a manifold **28**, an inlet **29**, zone valves **30** and **34**, and the nozzles **32** and **36**. The system **10** also comprises a controller **50** operatively connected to the master valve **22**, zone valves **30** and **34**, the flow meter **26**. The controller **50** is also operatively connected to an alarm **48**, a temperature sensor **46**, an output device **44** and an input device **42**.

The water source **20** is connected to the pump **24**. The water source **20** provides water to the system **10**, and may be linked to the municipal water system or any other source of water that may be available to the poultry house **12**. In other embodiments, the water source may provide water with additives and/or any other type of fluid.

The pump **24** is used to provide additional water pressure. In other embodiments, if there is sufficient water pressure, it may not be necessary to use a pump to provide additional water pressure. The pump **24** may be a GJPS2A115-PKG pump manufactured by Grundfos. In other embodiments, other suitable means of increasing the water pressure may also be used.

The master valve **22** is connected to the pump **24** as shown. The master valve **22** controls the flow of the water from the water source **20** to the nozzles **32** and **36**. The master valve **22** has an open position and a closed position. In the open position, the master valve **22** permits the water from the water source **20** to flow through. In the closed position, the flow of

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water through the valve is inhibited. The master valve **22**, which is in addition to zone valves **30** and **34**, serves as an added layer of control for limiting flow of water.

The master valve **22** may be an electronically controlled valve such as a solenoid valve. For example, the master valve **22** may be a $\frac{3}{4}$ inch AC inline globe valve with **24** VAC solenoid model #33-001 manufactured by Bermad Waterworks. The master valve **22** may also be another type of electronically controlled fluid control devices, such as a pneumatic valve. In other embodiments, the master valve **22** may be a hand-controlled valve that is not connected to the controller **50**.

The master valve **22** is connected to the flow meter **26**. The flow meter **26** provides a measurement of the volume of water that has been used by the system. This measurement may be used for monitoring purposes to determine total water usage of the system. The measurement may also be used to determine when to set one or more valves in the closed position as described herein below. In other embodiments, the flow meter **26** may not be used.

The flow meter **26** is connected to the manifold **28**. The manifold **28** facilitates the water from the single water source **20** to flow to a plurality of valves. As shown, the manifold **28** is connected to the zone valve **1** and zone valve **2** as indicated by numerals **30** and **34** respectively. The zone valves **30** and **34** may be electronically controlled valves such as the master valve **22** or the like. In other embodiments, there may be a different number of zone valves. The manifold **28** may also be connected to the inlet **29** as shown. The inlet **29** allows additives to be added to the water for various purposes such as cleaning the sprinkler lines, pre-soaking the litter with cleaning agent, other litter treatments, manure pit treatments, and odor control.

The zone valve **30** is connected to the nozzle **32**. As shown in FIG. 1, nozzle **32** is directed at the chicken **14** such that when the system **10** is activated, water from the water source **20** is sprayed at the chicken **14** through the nozzle **32**. Similarly, the zone valve **34** is connected to the nozzle **36**, which is directed at the chicken **15**.

As shown, each of the valves **30** and **34** is connected to a single nozzle **32** and **36** respectively. In other embodiments, it is possible connect multiple nozzles to each valve, with each valve defining a zone of operation. By organizing the nozzles in zones, it is possible to control operation of multiple nozzles in each zone. The number of nozzles in a zone may be limited by the amount of available water pressure as the water pressure at each nozzle is inversely related to an increase in the number of nozzles connected to each valve. In other embodiments, it may also be possible to use multizone valves instead of having multiple valves.

Each of the nozzles **32** and **36**, for example, may be a spinner assembly comprising a model AT77-930212 spinner, a AT77-930509 nozzle, a AT77-930100 bridge, and a AT77093120 leak prevention device manufactured by Dan Sprinklers. In other embodiments, the nozzles **32** may be other types of nozzles. For example, nozzles manufactured by DIG Corporation or Netafim may be used. Nozzles may be selected to permit customization of sprinkler drops to avoid obstacles such as heaters, tunnel curtains, circulation fans, feed hoppers, and lights by sprinkling over or under the obstacles.

In other embodiments, the system **10** may also include sprinkler deflectors to avoid sprinkling unwanted areas such as circulation fans, feed hoppers, electrical boxes, etc. The sprinkler system may also include sprinkler plugs to keep an area temporarily free of sprinkling.

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The system **10** comprises a controller **50** which is connected various components of the system **10**. The controller **50** is connected to the master valve **22**, the zone valve **30**, and the zone valve **34**. The controller **50** may be wired to the valves such that electrical signals may be received at the valve, and interpreted to control the operation of the valve by either setting the valves in the open position or the closed position. The controller **50** is wired to each valve such that it is possible to control the operation of each valve individually. The controller **50** is also connected to the flow meter **26** for obtaining measurements from the flow meter **26**.

Referring now to FIG. 3, illustrated therein is a block diagram of the controller **50** according to one embodiment. The controller **50** comprises at least one data storage device **54** operatively connected to at least one processor **56**. The data storage device **54** may store instructions for programming the processor **56**. The data storage device **54** may also store configuration settings for the controller **50**.

In some embodiments, there may be more than one data storage device **54**. The data storage device **54** may be volatile or non-volatile computer memory. If there are more than one data storage devices, the data storage devices may be different types of memory. For example, the type of memory for storing instructions to program the processor **56** may be different from the type of memory for storing configuration settings of the controller **50**.

The controller **50** includes an input/output module **58** operatively connected to the processor **56**. The input/output module **58** facilitates communications between the processor **56** and the components of the system **10** that the controller **50** is connected to. The input/output module **58** may also facilitates communication between a user of the system and the controller **50**. In the embodiment as shown, the input/output module **58** is connected to the master valve **22**, the zone valves **30** and **34**, the alarm **48**, the flow meter **26**, the temperature sensor **46**, the input device **42** and the output device **44**.

The input/output module **58** may be a single unit or a combination of multiple different units. The input/output module **58** may comprise a digital to analog converter, and/or an analog to digital converter depending on the component that it is connected to. For example, the input/output module **58** may include a digital to analog converter to connect to the master valve **22**, and the zone valves **30** and **34** such that the digital instructions to change the state of the valves between the open and close positions may be communicated to the valves through an electrical wire by varying the current or the voltage.

The controller **50** may include a housing **52** for housing one or more components of the controller **50**. The housing **52** may be manufactured from plastic, metal or any other suitable material. The housing **52** insulates various components of the controller **50** from potentially harmful elements in the environment such as dust and moisture. In the embodiment as shown, the housing **52** houses a memory **54**, a processor **56**, and an input/output module **58**. In other embodiments, another combination of the components of the controller **50** may be found outside the housing **52**. In other embodiments, a housing may not be used at all. In other embodiments, some of the components may be integrally formed with the housing **52**. The housing **52** is configured permit wires or other connectors to access the input/output module **58**.

Referring now to FIG. 4, illustrated therein is a top view of an exemplary housing **52** according to one embodiment of the invention. The housing **52**, in this embodiment, has input device **42** in the form of buttons **42a-42d** integrated to the housing. These buttons may be used to provide user input to

the controller **50**. The user input may be used to determine settings for the controller **50** such as the duration of the activity promotion interval, the start time of the activity promotion interval, and/or the frequency of the activity promotion interval. The exemplary housing **52** also has output devices **44** in the form of a LCD display **44a** and a LED display **44b**. The LCD display **44a** indicates what the numerical value displayed in the LED display **44b** represent. As shown the number "12:00" represents the time (12:00 am) in a 24 hr format. Other parameters may be viewed by using the "List" buttons **42a** and **42b** to toggle through a list of available parameters. Some of the parameters may be adjusted by using the "Set" buttons **42c** and **42d**.

The processor **56** may be a programmable microprocessor. For example, the microprocessor may be a Core 100 Model X1255 microprocessor. The processor **56** controls the operation of the valves **22**, **30** and **34** connected to the controller **50** by providing control signals through the input/output module **58** to each of the valves **22**, **30**, and **34** to indicate whether the valves should be in the open position or the closed position. Each of the valves **22**, **30**, and **34** may be controlled individually. To permit flow of water from the water source **20** to the poultry **14** and **15**, the master valve **22** and at least one of the zone valves **30** and **34** must be in the open position.

The processor **56** is programmed to set the valves in an open position at a start of an activity promotion interval, and to set the valve to the closed position at the end the activity promotion interval. The activity promotion interval starts when the valves are set in the open position such that a sufficient amount of fluid is dispersed through the sprinkler nozzles **32** and/or **36** at the poultry to promote physical activity in the poultry. The valves are then set in the closed position at the end of the activity promotion interval before an excessive amount of fluid is dispersed into the poultry house **12**.

The poultry naturally prefer to remain in a seated state. Being in a seated position for long periods may result in an uneven distribution of heat in the poultry as the area between the poultry and the floor tends to be warmer than the rest of the poultry. It is desirable to alleviate the uneven distribution of heat in the poultry by encouraging the poultry not to be in the seated position periodically to permit the heat trapped between the poultry and the floor poultry house to escape.

When a sufficient amount of fluid is dispersed at the poultry, the poultry is prompted to get up and move towards the watering trough **16** to consume water. Increased water consumption may be beneficial to the health of the poultry. Prompting the poultry to get up and move towards the watering trough **16** also promotes physical activity in the poultry. That is, the system may be used to exercise the poultry, and the act of exercising may be beneficial to the health of the poultry. In some embodiments, the sprinkler system may be used to promote water consumption by the poultry. The poultry also release heat trapped between the poultry and the floor, which cools the poultry as the poultry get up from their resting position.

In addition, dispersing fluid into the poultry house may also inhibit the dust levels within the poultry house. This may reduce chance of bacterial infection in the respiratory track of the poultry in the poultry house.

Referring to FIG. 5, illustrated therein is a table **70** listing at least some of the factors that may affect the duration and/or the frequency of the activity promotion interval. The duration of the activity promotion interval is selected such that a sufficient amount of water is dispersed for activity promotion without over-watering the poultry house **12**. The start of each activity promotion interval is predetermined based on a frequency of operation parameter indicative of the number of

times the activity promotion interval is ran in a given period of time. For example, the activity promotion interval may occur 10 times in a given 10-hour window. In that case, the start time may be evenly distributed by dividing the given period of time with the number times the activity promotion interval is being ran, which results in the activity promotion interval being ran once every hour. In other examples, the start time may not be evenly distributed.

A value for the frequency of operation parameter is selected to promote the rate of growth of the poultry. The rate of growth may be affected by a number of different factors. For example, to promote growth of the poultry, it may not be desirable to run the activity interval when the age of the flock of poultry is below a certain growth day. Accordingly, the frequency of operation value may be selected based on the age of the poultry being housed.

The value of the frequency of operation may differ based on purposes for which the poultry is being raised. For broiler chickens, the activity promotion frequency value may be set at 10 times a day after the chickens are 21 days old, and the activity promotion interval not run (i.e. frequency set to 0) when the chickens are younger than 21 days. For breeding chickens and breeding turkeys, the frequency value may be set at 10 times a day after these chickens and turkeys are 12 weeks old, and the activity promotion interval not run prior to that age.

The value of the frequency of operation may differ based on different types of poultry to promote growth of different types of poultry. For example, the value for the frequency of operation for turkeys may be different from that for chickens. The sex of the poultry may also affect the duration of the activity promotion interval.

Depending on different factors, the value of the frequency of operation may range from 0 times a day to 20 times a day. Typically, the value of the frequency of operation ranges from 0 times a day if the poultry is younger than a certain age, and 10 times a day once the poultry is older than the selected age as described above. In other embodiments, the frequency of operation may occur for a different range.

The start time of the activity promotion interval may also be predetermined based on time of day. For example, it may be undesirable to disturb resting poultry at nighttime by activating the sprinklers. As such, the start time of the activity promotion interval may be limited to daylight hours. For example, the start time may be between 6:00 in the morning to 19:00 hr in the evening in some areas. It is also possible that the frequency of operation may vary based on the current time of a day. For example, the frequency of operation may increase between 6:00-9:00 hr and 16:00-19:00 hr to promote more physical activity during the early morning and later evening.

As stated above, the duration between the start and the end of the activity promotion interval is selected so as to promote physical activity in the poultry without dispersing an excessive amount of water into the poultry house **12**. It is possible that if only a small amount of water is sprayed at the poultry, the poultry may not be stand up and move around. On the other hand, if too much water is sprayed at the poultry, it will accumulate at the floor of the poultry house **12**, which is undesirable. Accordingly, it is desirable to select an appropriate duration of the activity promotion interval such that the amount of water dispersed is sufficient to promote physical activity without over-watering the poultry house **12**.

The duration of the activity promotion interval may be selected based on the type of poultry being housed to promote physical activity in the poultry. For example, the duration may be 20 seconds for chickens, ducks, and geese, and the dura-

tion may be 30 seconds for turkeys. The sex of the poultry may also affect the duration of the activity promotion interval. The duration of the activity promotion interval may range from 15 seconds to 45 seconds depending on the type of the poultry being housed.

In addition to operating activity promotion intervals, the processor **56** may be further programmed to set the valve in an open position at a start of a cooling interval, and set the valve to the closed position at an end the cooling interval for the purpose of cooling the poultry house **12**. During the cooling interval, a sufficient amount of fluid is dispersed through the sprinkler nozzle to reduce the temperature within the poultry house **12**. As stated before, this may cause the poultry to stand-up, which releases heat that is trapped between the poultry and the floor. The droplets of fluid on the birds combined with rapid air movement will also help to lower the bird's body temperature. The start of the cooling interval is determined based on the temperature value of the poultry house **12**, which is obtained through the temperature sensor **46**.

The duration of the cooling interval may differ based on the temperature of the poultry house **12**. For example, the duration of the cooling interval may be 20 seconds if the temperature is between 80-84 degrees Fahrenheit, 40 seconds for 85-89 degrees Fahrenheit, and 60 seconds if is over 89 100 degrees Fahrenheit. In other embodiments, the duration of the cooling interval may be constant. The frequency of the cooling interval may be increased depending on the temperature of the poultry house **12**. For example, the frequency of the cooling interval may be once every 30 minutes for temperatures between 80-84 degrees, once every 15 min for 85-89 degrees, and once every 5 min if the temperature is over 89 degrees Fahrenheit. In cases of extreme heat stress, the frequency of operation of the cooling mode may be as much as 192 times in a 24 hour period.

The processor **56** may be operating both cooling and activity promotion intervals. It is possible that if both intervals are run in close succession, too much water may be dispersed into the poultry house **12**. To prevent the activity promotion interval and cooling interval from running in short succession, a shared countdown timer may be used.

In one embodiment, the processor **56** may be programmed to start the activity promotion interval based on a count down timer. For example, the timer value may be initially set at 60 minutes. The timer will then count down, and when the value reaches "0", the processor **56** will start the activity promotion interval. The timer will then be reinitialized to 60 minutes at the end of the activity promotion interval, thereby providing a 60-minute wait before the activity promotion interval starts again. That is, the activity promotion interval is ran every hour. In other examples, the value of the timer may be different based on the frequency of the activity promotion interval. To prevent an activity promotion interval from starting too soon after a cooling interval, the processor **56** may be further programmed to reset the timer after a cooling interval, such that the activity promotion interval may not operate for the time remaining in the timer before starting another activity promotion interval.

Referring back to FIG. 2, the system **10** may also include an alarm **48**, which may be connected to the controller **50** as shown. The alarm **48** may provide an audible sound, or provide some other way of alerting a user of the system. The alarm may be based on the measurement provided by the flow meter.

The controller **50** is also connected to the flow meter **26**. The information from the flow meter **26** may be used by the controller **50** to prevent dispersing more than a desired

amount of water. The flow meter **26** may be used to provide a measurement of the total amount of fluid that has flowed through the fluid counter over a period of time, which can be used for water usage monitoring purposes. An exemplary flow meter **26** that may be used is 73WM055 ¾ water meter with pulse made by Arad. This information can be provided to the controller **50** through the I/O module **58**. The processor **56** may be programmed to use this information to provide an additional check as not to disperse undesired amount of water at the poultry house **12**. For example, the processor **56** may be programmed to set the valve in the closed position if the measurement from the fluid counter reaches a specified value. In other embodiments, a volumetric valve may also be attached to the system to provide a limit for the water expelled through the nozzles in cases of system or human error. For example, Bermad Waterworks 0-2600 gallon volumetric valve may be used.

Referring now to FIG. 6, illustrated therein is a method **100** for promoting physical activity of poultry in a poultry house according to one embodiment of the invention. The method **100** may be performed by a controller such as the controller **50** described above.

The method **100** begins at step **102**. At step **102** the method **100** electronically sets a valve in an open position to permit fluid to flow through the valve at a start of an activity promotion interval. The valve is connected to the fluid source and at least one sprinkler nozzle directed at the poultry. The valve controls a flow of fluid between a fluid source and the at least one sprinkler nozzle.

In some embodiments, there may be more than one valve. The valve used by the method **100** may be the valve **22**, **30** or **34** as described above, or similar valves. In other embodiments the valve used by the method **100** may be different from the valves **22**, **30**, and **34**. The sprinkler nozzle connected to the valve in the method **100** may be similar to the sprinkler nozzles **32**, and **36** described above, or the like. In other embodiments, the sprinkler nozzle used by the method **100** may be different from the nozzles **32** and **36**. The fluid source in the method **100** may be a water source similar to the water source **20** described above or the like. In other embodiments, the fluid source in the method **100** may be different from the water source **20**.

The start of the activity promotion interval may be determined by the frequency of operation parameter indicative of a number of activity promotion intervals in a time period. The value for the frequency of operation parameter is selected to promote growth of the poultry. In some embodiments, selecting the frequency of operation parameter for the method **100** may be similar to selecting the frequency of operation parameter for the controller **50** as described above. That is, the value for the frequency of operation may differ based on a number of different factors, such as the factors illustrated in the table **70**. For example, the value of frequency of operation may be selected based on the age of the poultry being housed. The value of the frequency of operation may also be selected based on different types of poultry to promote growth of the different types of poultry. The value of the frequency of operation may also differ based on desired weight of the poultry at the end of the growth cycle. The start time of the activity promotion interval may also be determined based on time of day, or the purposes for which the poultry is being raised.

The method **100** then proceeds to step **104**. At step **104**, the method **100** waits for the duration of the activity promotion interval. At this time, a sufficient amount of water is dispersed through the sprinkler nozzle at the poultry to promote physical activity in the poultry. After the method sets the valve in

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the open position, it waits for the duration of the activity promotion interval such that a sufficient amount of water is dispersed for activity promotion without over-watering the poultry house. This duration is selected to promote physical activity in poultry. In some embodiments, the duration of the physical activity promotion interval may be similar to the duration between the start and the end of the activity promotion interval that the processor in controller 50 is programmed to perform as described above. The duration of the activity promotion interval may also be affected by the factors illustrated in table 70.

The method 100 then proceeds to step 106. At step 106, the method 106 electronically sets the valve in a closed position to inhibit flow of fluid between the water source and the at least one sprinkler nozzle at the end of the activity promotion interval.

In addition to the activity promotion mode, the method 100 may also be operating in a cooling mode. If the method 100 is also operating in a cooling mode, the method 100 proceeds to step 108. At step 108, the method 100 obtains a temperature measurement from a temperature sensor. The temperature measurement is indicative of the temperature of the poultry house. The method proceeds to step 110.

At step 110, the method 100 determines whether the temperature value of obtained in step 108 exceeds at least one predefined threshold. For example, the predefined threshold may be 80, 84 or 89 degrees Fahrenheit. If it is determined that the temperature exceeds the at least one predefined threshold, the method 100 proceeds to step 110. If it is determined that the temperature does not exceed the predefined threshold, the method 100 ends at step 112.

At step 114, the method 100 electronically sets the valve in the open position at a start of a cooling interval. In some embodiments, the cooling interval performed by the method 100 may be similar to the cooling interval that the processor 56 in the controller 50 is programmed to perform as described above.

At step 116, the method 100 waits for a predetermined duration of the cooling interval. As stated above, the duration and/or the frequency of the cooling interval may differ based on the temperature of the poultry house.

At step 118, the method 100 sets the valve to the closed position at an end the cooling interval to prevent an excessive amount of fluid from being dispersed into the poultry house. As such, the method 100 balances between dispensing sufficient amount of water through the sprinklers to cool the poultry and the poultry house without over-soaking the poultry house.

Referring now to FIG. 7, illustrated therein is a method 150 for promoting activity in a poultry house according to another embodiment of the invention. The method 100 begins at step 152.

At step 152, the method 100 initializes a countdown timer based on a frequency of operation value for the activity promotion interval. For example, the countdown timer may be set to 60 minutes if the frequency of operation value is once every hour. The frequency of operation may be affected by various factors such as the type of poultry, the age of the poultry, the purpose of the poultry, as described above. The method 150 proceeds to step 154.

At step 154, the method 100 determines whether the current day is equal to or after the activity promotion interval start day. The activity promotion start day is the age of the poultry after which the activity promotion mode operates. The start day of the activity promotion interval may depend on the type of poultry being housed, and the purpose for it is housed. For example, for broiler chickens the activity promo-

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tion starts operation after the chickens are 21 days old. In another example, if the poultry comprise chickens and turkeys used for breeding, the activity promotion interval starts when the poultry is 12 weeks old. If it is after the activity promotion start day, the method 150 proceeds to step 164. Alternatively, the method 150 proceeds to step 156.

At step 156 the method 150 determines whether the current time is within operational time of day activity promotion interval. That is, the method 150 determines whether the current time is at the time of day when activity promotion interval may operate. For example, this could be between 06:00 hr-16:00 hr. If the current time is not within the daily activity promotion interval operation time, the method 150 proceeds to step 164. Alternatively, the method 150 proceeds to step 158.

At step 158, the method 150 determines if the value of the countdown timer is 0. If the value of the count down timer is not 0, the method 150 proceeds to step 164. Alternatively, the method 150 proceeds to step 160.

At step 160, the method 150 operates the activity promotion interval. That is, the method 150 electronically sets a valve in an open position to permit fluid to flow through the valve at a start of an activity promotion interval. The valve controls a flow of fluid between a fluid source and at least one sprinkler nozzle directed at the poultry.

In some embodiments, there may be more than one valve. The valve used by the method 150 may be the master valve 22, zone valves 30 and 34 as described above or similar valves. In other embodiments the valve used by the method 150 may be different from the valves 22, 30, and 34.

The sprinkler nozzle connected to the valve in the method 150 may be similar to the sprinkler nozzles 32, and 36 described above, or the like. In other embodiments, the sprinkler nozzle used by the method 150 may be different from the nozzles 32 and 36. The fluid source in the method 150 may be a water source similar to the water source 20 described above or the like. In other embodiments, the fluid source in the method 100 may be different from the water source 20.

The method 150 then waits for a predetermined duration of the activity interval, the duration being selected such that a sufficient amount of fluid is dispersed through the sprinkler nozzle at the poultry to promote physical activity in the poultry without over soaking the poultry house. In some embodiments the duration of the physical activity promotion interval may be similar to the duration between the start and the end of the activity promotion interval that the processor in controller 50 is programmed to perform in the embodiment as described above. The duration of the activity promotion interval may be affected by the factors illustrated in table 70.

The method then electronically sets the valve to a closed position to inhibit fluid from flow through the valve at the end of the activity promotion interval to prevent an excessive amount of fluid from being dispersed into the poultry house. After the activity promotion interval is ran, the method 150 proceeds to step 162.

At step 162, the method 150 reinitializes the countdown timer based on the frequency of operation parameter indicative of a number of activity promotion intervals in a time period. The value for the frequency of operation parameter is selected to promote growth of the poultry. In some embodiments, selecting the frequency of operation parameter for the method 150 may be similar to selecting the frequency of operation parameter for the controller 50 as described above. That is, the value for the frequency of operation may differ based on a number of different factors, such as the factors illustrated in the table 70. For example, the value of frequency of operation may be selected based on the age of the poultry

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being housed. The value of the frequency of operation may also be selected based on different types of poultry to promote growth of the different types of poultry. The value of the frequency of operation may also differ based on desired weight of the poultry at the end of the growth cycle. The start time of the activity promotion interval may also be determined based on time of day, or the purposes for which the poultry is being raised.

The method 150 then proceeds to step 164. In some embodiments, the method 150 may wait for a predetermined amount of time (e.g. 30 minutes) before proceeding to step 164 such that the activity promotion interval and the cooling interval is not run in close succession.

At step 164, the method 150 determines whether the current day is equal to or after the cooling interval start day. The cooling interval start day is the age of the poultry after which the cooling interval may operate. In some embodiments, the cool start day may be set to "0" indicating that the cooling interval may run regardless of the age of the poultry. If it is after the cooling interval start day, the method 150 proceeds to step 168. Alternatively, the method 150 returns to step 154.

At step 168 the method 150 determines whether the current time is within operational time of day for cooling interval. That is, the method 150 determines whether the current time is at the time of day when cooling interval may operate. For example, this could be between 06:00 hr-16:00 hr. If the current time is not within the daily cooling interval operation time, the method 150 returns to step 154. Alternatively, the method 150 proceeds to step 170.

At step 170, the method 150 determines whether the current temperature of the poultry house is above a first threshold. The method 150 may use a temperature sensor to obtain the temperature value. For example, the first threshold may be 80 degrees Fahrenheit. If the temperature is not above the first threshold, the method 150 returns to step 154. Alternatively, the method 150 proceeds to step 172.

At step 172, the method 150 determines whether the current temperature of the poultry house is above a second threshold. For example, the second threshold may be 85 degrees Fahrenheit. If the temperature is not above the second threshold, the method 150 proceeds to step 174. Alternatively, the method 150 proceeds to step 176.

At step 174, the method 150 operates the cooling interval. That is, the method 150 sets the valve in the open position at a start of a cooling interval such that water from the water source may flow through the valve to the nozzles to be dispersed into the poultry house. It then waits for a predetermined duration of the cooling interval, the duration being selected such that a sufficient amount of fluid is dispersed through the sprinkler to reduce the temperature within the poultry house. It electronically sets the valve to the closed position at an end of the cooling interval to prevent an excessive amount of fluid from being dispersed into the poultry house. The method 150 then proceeds to step 175.

At step 175, the method 150 reinitializes the countdown timer to a first value based on the first temperature threshold. For example, the countdown timer may be set to 30 minutes. By reinitializing the shared countdown timer, the method 150 prevents the sprinklers operating in the cooling interval and activity interval in a close succession. The method then proceeds to step 190.

At step 176, the method 150 determines whether the current temperature of the poultry house is above a third threshold. For example, the third threshold may be 90 degrees Fahrenheit. If the temperature is not above the third threshold, the method 150 proceeds to step 178. Alternatively, the method 150 proceeds to step 182.

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At step 178, the method 150 operates another cooling interval. This cooling interval may be similar in duration to the cooling interval in method step 174. In another embodiment, the cooling interval may be of longer duration than the cooling interval step 174 since the temperature threshold is higher. After the cooling interval is ran, the method 150 proceeds to step 180.

At step 180, the method 150 reinitialize the countdown timer to a second value based on the second temperature threshold. For example, the countdown timer may be set to 15 minutes. In some embodiments, the second value may be the same as the first value in step 175. The method then proceeds to step 190.

At step 182, the method 150 operates in yet another cooling interval. This cooling interval may be similar in duration to the cooling interval in method step 174 and/or step 178. In another embodiment, the cooling interval may be of longer duration than the cooling interval step 174 and/or step 178 since the temperature threshold is even higher. After the cooling interval is ran, the method 150 proceeds to step 184.

At step 184, the method 150 reinitialize the countdown timer to a third value based on the third temperature threshold. For example, the countdown timer may be set to 5 minutes. In some embodiments, the second value may be the same as the first value in step 175, or the second value in step 180. The method then proceeds to step 190.

At step 190, the method waits until the value of the countdown timer is equal to "0". Method 150 then returns to step 164.

While the steps of the above methods have been described sequentially hereinabove, it should be noted that sequential performance of the steps may not need to occur for successful implementation of the method. As will be evident to one skilled in the art, rearranging sequence of performance of the steps, omitting the performance of some steps, or performing the steps in parallel may be possible without abandoning the essence of the invention.

While certain features of the invention has been illustrated and described herein, many modifications, substitutions, changes, and equivalents will now occur to those of ordinary skill in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the invention.

The invention claimed is:

1. A sprinkler controller for a poultry house, the sprinkler controller comprising:

- a) a processor;
- b) a data storage device operatively connected to the processor, the data storage device having instructions for operating the processor; and
- c) an input-output module operatively connected to the processor, wherein the input-output module communicates with at least one valve to control a flow of fluid between a fluid source and at least one sprinkler nozzle, the at least one valve having an open position permitting the flow of fluid, and a closed position inhibiting the flow of fluid, the position of the valve being determined by the processor;
- d) wherein the processor operates in an activity promotion mode, in which the processor sets the valve in the open position at a start of each of a plurality of activity promotion intervals, and sets the valve in the closed position at an end of the activity promotion intervals, a duration of the activity promotion intervals being selected such that fluid is dispersed through the sprinkler nozzle thereby promoting, physical activity in poultry housed in the poultry house, the start of each activity promotion

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interval being based on a frequency of operation parameter indicative of a number of activity promotion intervals in a given time period, and a value for the frequency of operation parameter being selected to promote growth of the poultry, wherein the processor operates the valve so as to create the flow of fluid during the activity promotion intervals independently of temperature.

2. The sprinkler controller according to claim 1, wherein the value for the frequency of operation parameter is selected based on an age value indicative of an age of the poultry.

3. The sprinkler controller according to claim 2, wherein the value for the frequency of operation parameter is selected based on a type of poultry being housed.

4. The sprinkler controller according to claim 1, wherein the duration of the activity promotion interval is selected based upon a type of poultry being housed to promote physical activity in the type of poultry being housed.

5. The sprinkler controller according to claim 1, wherein the start of at least one of the activity promotion intervals is also based on a time of day.

6. The sprinkler controller according to claim 1, wherein the input-output module is further configured to connect to at least one user input device for receiving user input, and the processor determines at least one of the duration, the start and the frequency of the activity promotion interval based on the user input.

7. The sprinkler controller according to claim 1, wherein the input-output module is further configured to provide a cooling mode in addition to the activity promotion mode by connecting to a temperature sensor for obtaining a temperature value of the poultry house, and wherein the processor also operates the cooling mode by setting the valve in an open position at a start of a cooling interval when the temperature value exceeds a first threshold, and setting the valve to the closed position at the end of the cooling interval such that a sufficient amount of fluid is dispersed through the sprinkler nozzle during the cooling interval to reduce the temperature value within the poultry house and to cool the poultry.

8. The sprinkler controller according to claim 7, wherein the processor provides a timer to determine the start of the activity promotion interval, start the activity promotion interval when the timer reaches a specified value, and reinitialize the timer at the end of the activity promotion interval and the end of the cooling interval.

9. The sprinkler controller according to claim 7, wherein the processor runs the cooling interval at an increased frequency when the temperature value exceeds a second threshold.

10. The sprinkler controller according to claim 1, wherein the processor is further connectable to a flow meter for obtaining a measurement of a volume of fluid dispersed through the at least one sprinkler nozzle, and wherein the processor activates an alarm when the flow meter measurement exceeds a specified value.

11. The sprinkler controller according to claim wherein at least one of the duration and the start of the activity promotion interval, and the frequency of operation parameter is selected to promote health of the poultry.

12. The sprinkler controller according to claim 1, wherein the duration of the activity promotion intervals falls within a range of 5-60 seconds.

13. The sprinkler controller according to claim 1, wherein the duration of the activity promotion intervals falls within a range of 15-45 seconds.

14. The sprinkler controller according to claim 1, wherein the number of activity promotion intervals falls within a range of 5-15 per day.

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15. The sprinkler according to claim 1, wherein the frequency of operation parameter fails within a range of 10-20 per day.

16. A sprinkler system for a poultry house for housing poultry, the sprinkler system comprising:

- a) at least one sprinkler nozzle;
- b) a fluid source connected to the at least one sprinkler nozzle;
- c) at least one electronically controlled valve connected to the fluid source and the sprinkler nozzle to control the flow of fluid, the valve having an open position permitting the flow of fluid, and a closed position inhibiting the flow of fluid, and
- d) a controller comprising a processor, a data storage device operatively connected to the processor, the data storage device having instructions to program the processor, an input-output module operatively connected to the processor, wherein the input-output module communicates with the at least one valve to set the position of the valve;
- e) wherein the processor in the controller operates in an activity promotion mode, in which the processor sets the valve in the open position at a start of each of a plurality of activity promotion intervals, and sets the valve in the closed position at the end of the activity promotion intervals, a duration of the activity promotion interval being selected such that fluid is dispersed through the sprinkler nozzle thereby promoting physical activity in poultry housed in the poultry house, the start of each activity promotion interval being based on a frequency of operation parameter indicative of a number of activity promotion intervals in a given time period, and a value for the frequency of operation parameter being selected to promote growth of the poultry, wherein the processor operates the valve so as to create the flow of fluid during the activity promotion intervals independently of temperature.

17. A sprinkler controller for a poultry house comprising:

- a) a processor;
- b) a data storage device operatively connected to the processor, the data storage device having instructions for operating the processor, and;
- c) an input-output module operatively connected to the processor, wherein the input-output module communicates with at least one valve for controlling a flow of fluid between a fluid source and at least one sprinkler nozzle, the at least one valve having an open position permitting the flow of fluid, and a closed position inhibiting the flow of fluid, the position of the valve being determined by the processor;
- d) wherein the processor operates in an activity promotion mode, in which the processor sets the valve in the open position at a start of each of a plurality of activity promotion intervals, and sets the valve in the closed position at the end of each activity promotion interval, a duration of the activity promotion interval being selected such that fluid is dispersed through the sprinkler nozzle, thereby promoting physical activity in poultry housed in the poultry house, and wherein the processor operates a selected number of the activity promotion intervals in a day independent of a temperature value indicative of the poultry being exposed to heat stress, the number of activity promotion intervals being selected to promote growth of the poultry.

18. The sprinkler controller according to claim 17, wherein the physical activity comprises exercise and consumption by the poultry.

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19. The sprinkler controller according to claim 17, wherein the number of the activity promotion intervals is selected based on an age value indicative of an age of the poultry.

20. The sprinkler controller according to claim 17, wherein the value for the number of the activity promotion intervals is selected based on a type of poultry being housed.

21. The sprinkler controller according to claim 17, wherein the duration of the activity promotion interval is selected based upon a type of poultry being housed.

22. The sprinkler controller according to claim 17, wherein the start time of at least one of the activity promotion interval is determined based on time of day.

23. The sprinkler controller according to claim 17, wherein the input-output module is further configured to connect to a temperature sensor for obtaining a temperature value of the poultry house, and wherein the processor also operates in a cooling mode, in which the processor sets the valve in an open position at a start of a cooling interval when the temperature value exceeds a threshold, and sets the valve to the closed position at the end the cooling interval such that a sufficient amount of fluid is dispersed through the sprinkler nozzle

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during the cooling interval to reduce the temperature value within the poultry house and to cool the poultry.

24. The sprinkler controller according to claim 17, wherein the processor is connected to a flow meter for obtaining a measurement of a volume of fluid dispersed through the at least one sprinkler nozzle, and wherein the processor activates an alarm when the flow meter measurement exceeds a specified value.

25. The sprinkler controller according to claim 17, wherein the number of activity promotion intervals in a day is greater than one when the poultry is older than a selected age.

26. The sprinkler controller according to claim 17, wherein the selected number of the activity promotion intervals is between 1 and 20 per day.

27. The sprinkler controller according to claim 26, wherein the selected number of the activity promotion intervals is between 5 and 16 per day.

28. The sprinkler controller according to claim 27, wherein the selected number of the activity promotion intervals is 10 per day.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 9,069,362 B2
APPLICATION NO. : 12/704885
DATED : June 30, 2015
INVENTOR(S) : Kevin S. Weeden

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

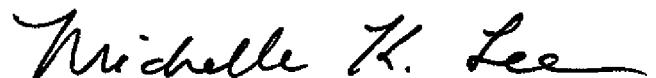
In the Claims,

Column 14, line 66 delete “thereby promoting, physical activity in poultry housed” and replace with “thereby promoting physical activity in poultry housed”.

Column 15, line 55 delete “The sprinkler controller according to claim wherein at” and replace with “The sprinkler controller according to claim 1, wherein at”.

Column 18, line 17 delete “between 5 and 16 per day” and replace with “between 5 and 15 per day.”.

Signed and Sealed this
Twenty-second Day of December, 2015



Michelle K. Lee
Director of the United States Patent and Trademark Office